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Interstitial Laser Hyperthermia, a New Method in the Management of Fibroadenoma of the Breast:
A Pilot Study

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Background and Objective: **This study attempts to evaluate the effect of interstitial laser hyperthermia in breast fibroadenomas as an outpatient procedure.**
Study Design/Materials and Methods: **In an uncontrolled prospective study, 27 patients younger than 35 years were subjected to laser phototherapy of their breast fibroadenomas. Under real-time ultrasound monitoring, Nd:YAG laser (1,064 nm wavelength) was used at 2 W for 300 sec (600 J) in a continuous wave mode to produce interstitial hyperthermia. Follow-ups were done at 2, 4, and 8 weeks. Subsequently, excision biopsy of residual lumps was performed.**
Results: **There was significant decrease in clinical and sonographic sizes (*P* < 0.001). Follow-up ultrasound showed a progressive change of hyperechoic texture, from a heterogeneous to a nearly homogeneous one. There were minimal scars (2–3 mm) and no keloid or abscess formation.**
Conclusion: **Interstitial laser hyperthermia is a safe, precise, and minimally invasive outpatient procedure for in situ destruction of breast fibroadenomas. Lasers Surg. Med. 25:148–152, 1999.**

Key words: benign breast disorders; breast fibroadenoma; Nd:YAG Laser; low power interstitial laser hyperthermia

INTRODUCTION

The most common form of benign breast mass seen in young women is fibroadenoma [1]. Although surgery has been the mainstay of therapy, the present trend is toward expectant treatment [2,3]. The lump may actually subside or its growth may be arrested over time [4]. However, even with high patient acceptability, complete cure, benefit of pathological examination, and the absence of a standardized protocol of management, fibroadenomas are still surgically excised in young women [5].

Hyperthermia as a mode of tumor therapy has been known since antiquity [6]. Various techniques are in popular, namely ultrasonic waves, microwaves, X-radiation, and radiofrequency waves [7–11]. The latest, most precise and predictable method is laser hyperthermia. Since its introduction in 1983, it has gained rapid popularity due to its minimally invasive nature and predictable tissue damage [12]. Various animal and human tissues, e.g., liver, brain, colon, skin, pancreas, prostate, hepatic metastasis, and breast carcinomas, have been used successfully to demonstrate the effects of interstitial laser hyperthermia (ILH) [13–25].

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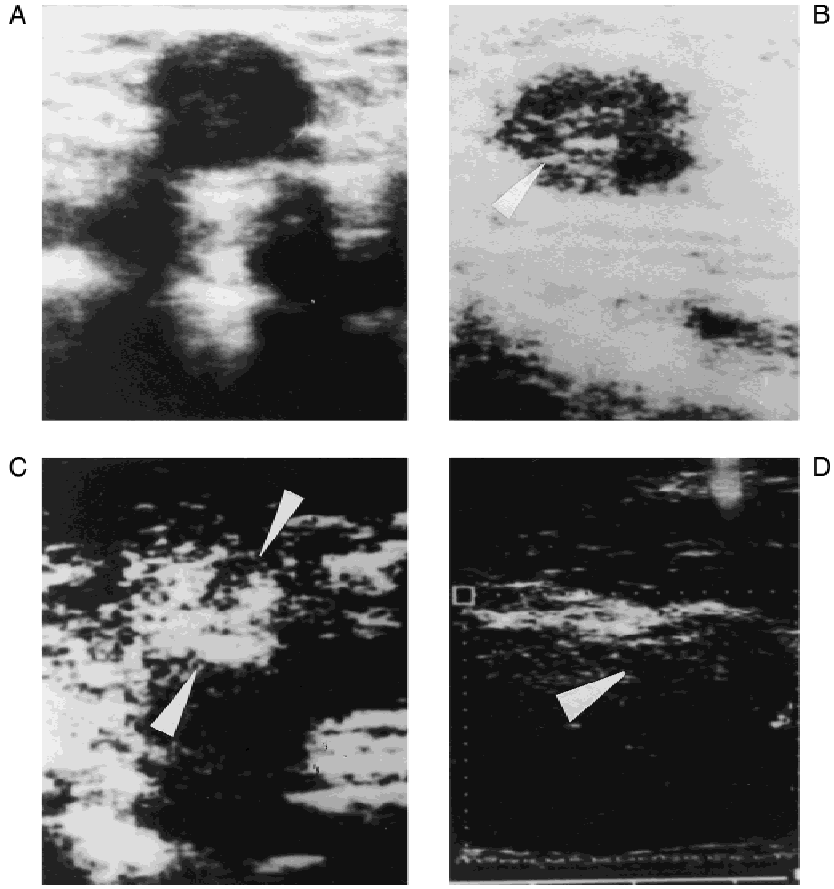

Fig. 1. Ultrasound scans. **A:** Fibroadenoma before start of therapy. **B:** After 10 sec of treatment, a hyperechoic area is seen at the center (arrowhead). **C:** Immediately after the procedure, the lump is visible (arrowheads). **D:** At the third follow-up, a diffuse hyperechoic area is seen merging with echoes of surrounding breast parenchyma.

In the present study, we used Nd:YAG laser to evaluate the effects of ILH in fibroadenomas of the breast as an outpatient procedure.

MATERIALS AND METHODS

Patients

Thirty consecutive patients younger than 35 years were selected from the Surgical Outpatients Department, Lady Hardinge Medical College, New Delhi, and treated on an outpatient basis. The selection criteria included (a) fibroadenoma, as confirmed on fine-needle aspiration cytology; (b) lumps up to 2 cm, as assessed clinically, and (c) written informed consent for laser therapy. Exclusion criteria were pregnancy, age older than 35 years, and lumps of less than 1 year in duration. Of these 30 patients, three were lost to follow-up and were omitted from the study.

Equipments

A laser machine (Lasermatic, model 5050-23, Combolaser, Helsinky, Finland) with Nd:YAG (1,064 nm) bare quartz fibers of 600 μ in diameter was used.

The ultrasound (US) machine used was a real-time B mode scanner (Hondex HS-310, Honda Electronics Co. Ltd., Aichi-Ken, Japan), with a high-frequency (7.5 Mhz) linear array probe.

Methods

The breast lumps were assessed sonographically to note the nature, dimensions (three axes), and positions (Fig. 1A). Clinical sizes were calculated in two axes.

Under infiltration anesthesia (1% xylocaine) and with constant sonographic guidance, a 16-G steel needle was introduced through the skin into the center of the lump.

A presterilized, freshly cleaved bare Nd:YAG fiber (600 μ in diameter) was passed through the needle and positioned to keep 3–4 mm of the bare tip at the center beyond the needle.

Two watts of laser energy were delivered in a

TABLE 1. Age Distribution of Patients

Age (years) group	Frequency (%)	Cumulative frequency
10–15	2 (7.4)	2
16–20	11 (40.7)	13
21–25	8 (29.63)	21
26–30	4 (14.3)	25
31–35	2 (7.4)	27

continuous wave mode for 300 sec. Throughout the procedure, the sequence of changes in the lump was monitored by continuous real-time US. At the end of the procedure, both the needle and the fiber were withdrawn carefully. Mild bleeding, when present, was controlled with pressure. A nonsteroidal analgesic was prescribed for a few days.

The patients were called for follow-up at the second, fourth, and eighth week. During these visits, the local area was clinically examined, and the sizes of the lumps were assessed. Any complication or side effect, e.g., infection, discharge, or epithelial breakdown, was noted.

Sonographic assessment included volume estimation and echotextural changes of the lumps. At 8 weeks, 10 patients with residual lumps of more than 1 cm in diameter underwent excision biopsy with subsequent histopathological examination.

RESULTS

The mean age of the cohort was 21.77 years (range = 14–35 years). Forty percent of the patients were 16–20 years (Table 1). The mean duration of the lumps was 16.4 months. Intraprocedure ultrasound monitoring showed the appearance of a hyperechoic area in the center of the lump by 8–10 sec (Fig. 1B). The center progressively increased to occupy almost the entire lump by 300 sec (Fig. 1C). Hyperechoic streaks radiating from the center were seen after 150–200 sec. All patients complained of a sensation of warmth felt locally, which subsided with the procedure.

Immediate postprocedural US showed a hyperechoic zone occupying the entire lump, with a narrow hypoechoic rim (0.3–0.5 cm). Blanching of the skin around the needle was seen in eight patients. It started after about 80–100 sec of lasing and persisted throughout the procedure. All these patients later developed epithelial breakdown and hyperpigmentation in the same area.

Follow-up

At the first follow-up (2 weeks) on clinical examination, the lumps were slightly bigger except for four patients in whom decrease in the size was seen. In all patients the lumps were tender and less mobile. US showed a decrease in the size of the lump and a narrower hypoechoic rim.

In the second follow-up (4 weeks), the lumps were mildly tender, the sizes had decreased and mobility was still restricted. US showed a heterogeneous echopattern.

Follow-up at 8 weeks showed further reduction in size in all, although mild tenderness was still present. In two patients, small nodules smaller than 0.5 cm only were palpable. US showed decrease in size and a nearly homogeneous or a heterogeneous echopattern that, at places, had merged with the echoes of normal breast parenchyma (Fig. 1D).

Side effects were evident by the first follow-up. Epithelial breakdown around the skin puncture site was noted in eight patients who had skin blanching during laser therapy (3–5 mm in diameter). It subsequently healed with hyperpigmentation. Mild discharge of greyish white, cheesy material was observed at the puncture site in two patients. It was nonpurulent and subsided in a few days. No keloid formation, local infection, or abscess was seen.

Histopathology

Ten patients in whom the residual lumps were larger than 1 cm in diameter underwent excision biospy. The gross specimens were fibrotic and intensely adhered to the surrounding breast parenchyma, unlike normal fibroadenomas, which have a definite cleavage plane. Histopathology demonstrated predominantly fibrosis and scarring.

Data were analyzed by the paired t-test. Statistically significant decrease in size was found both clinically ($P < 0.001$) and sonographically ($P < 0.001$). The majority showed a decrease in the range of 60–70% on US and 40–50% clinically (range = 40–100% and 20–90%, respectively; Fig. 2). Two patients showed a 100% decrease in size on US, although both had a tiny palpable nodule (<0.5 cm). The sequential changes in the mean size of the breast lumps on clinical assessment showed an initial increase followed by a progressive decrease, whereas those assessed sonographically showed a continuous decrease (Table 2).

DISCUSSION

Lumps of more than 1 year in duration were selected because 20% of fibroadenomatous lumps

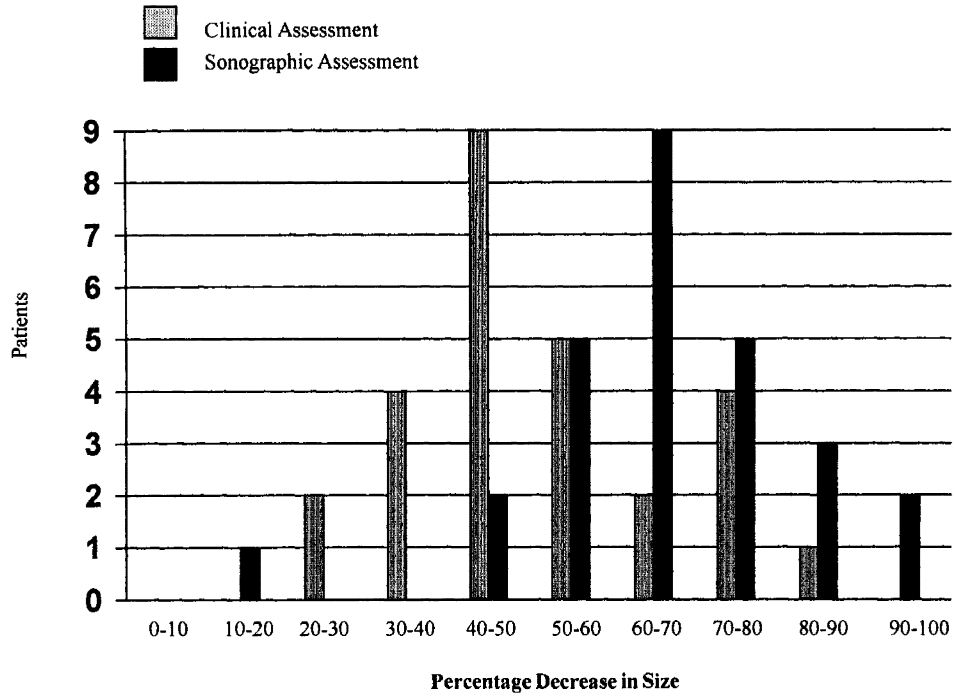

Fig. 2. Bar diagram showing the percentage of decrease in size of the lumps as assessed clinically and sonographically.

TABLE 2. Changes in the Mean (± SD) Size of the Breast Lumps

	Clinical assessment (cm^2)		Ultrasound assessment (cm^3)	
	Mean	SD	Mean	SD
Preprocedure	2.60	0.79	2.17	1.03
First follow-up	2.83	0.98	1.56	0.69
Second follow-up	1.89	0.65	0.98	0.45
Third follow-up	1.25	0.60	0.68	0.39

in young women subside spontaneously over a year [4]. Opinion is divided regarding the management of discrete breast lumps in patients older than 40 years. Most surgeons would advise excision biopsy. Hence, only women younger than 35 years were included in this study.

The sensation of warmth felt locally by the patients, which spontaneously subsided with completion of therapy, was probably due to dissipation of heat by the blood vessels to the surrounding breast parenchyma. This dissipation does not occur in malignant tumors [11,26].

The necrosis seen on US as a hyperechoic center progressively develops with the delivery of laser energy has been previously described [25,27,28]. In the present study, we found it developing within 10 sec of starting the laser. After 150–200 sec, hyperechoic streaks were seen to radiate away from the central zone, a finding that has been reported previously and is known to be due to micro gas bubbles [25,27].

Follow-up US showed a gradual diffusing appearance of the central zone and a progressive decrease in the peripheral hypoechogenic zone. At the end of 8 weeks, internal echoes were seen merging with that of the surrounding normal breast parenchyma in most of the lumps, suggesting a reparative process [14].

The range of necrosis in relation to laser wattage has been demonstrated previously in rat mammary tumors and in carcinoma of the breast [22,23]. In the present study, the lesion diameter ranged from 1.5 to 1.8 cm. All fibroadenomas are not the same with respect to adenomatous and fibrous components, which might have influenced the extent of necrosis seen.

The apparent increase in size of the lumps at first follow-up may be attributed to the inflammatory edema, which is corroborated by the finding of tenderness and fixity of the lumps. On subsequent follow-ups, edema subsided and the dimensions decreased. A further decrease in size may be expected in longer follow-up. Healing was safe and uneventful in all but eight patients in whom epithelial breakdown with hyperpigmentation occurred at the needle puncture site, which could be attributed to the superficial positions of the lumps (distance from skin surface ≅ 0.5 cm).

CONCLUSION

ILH is a safe, precise, and simple method for in situ destruction of fibroadenoma of the breast. Observations suggest a highly probable role of ILH in outpatient surgeries. It is minimally invasive and is cosmetically and functionally acceptable in young women, especially those prone to keloid formation following a surgical scar. Patients requiring treatment for multiple fibroadenomas can safely have multiple sessions. However, proper standardization of the energy requirements in relation to the lump size and a longer follow-up are required for achieving the best results.

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